SCIENCE 8

MODULE 5:
Growing Plants

STUDENT SUPPORT GUIDE

Distance Learning

Alberta EDUCATION

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Note to the Parent or Guardian

This Science Student Support Guide contains answers to activities in the accompanying Module Booklet. It should be kept secure by the parent or guardian if the student is under 16 years of age. Younger students should not have access to this Guide except under supervision.

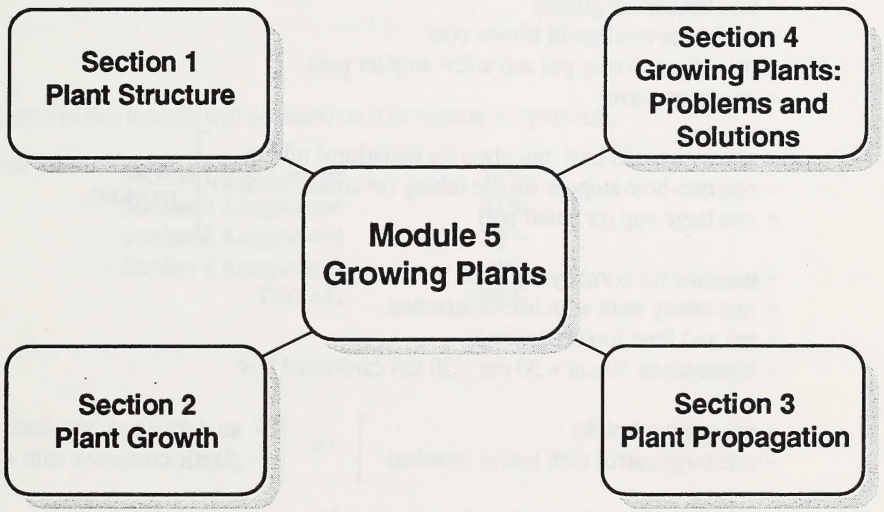
This Student Support Guide does not contain the answers to the accompanying Assignment Booklet. The Assignment Booklet will be graded by the student's distance education teacher.

Science 8
Student Support Guide
Module 5
Growing Plants
Alberta Distance Learning Centre
ISBN No. 0-7741-0509-7

Module 5 – Growing Plants: Overview

The major emphasis of this module is science and technology.

This module is a study of plant structures and their functions, plant growth, plant propagation, soil characteristics as they relate to plant needs, and plant pests and diseases. This knowledge is applied to the management of plant growth.



Moving through the Module

In this module there are activities that must be completed over a number of days because they involve the growing of plants. In order to facilitate student progress, students can work on these activities concurrently with other activities. Section 2, Activity 5 may be completed as students work on subsequent activities. Students can start the growing of the carrot or African violet for Section 3, Activity 3 when they reach Section 2. Students can begin the plant growth investigation for Section 4, Activity 3 when they have radish or bean plants available and have some ideas about what factors affect plant growth.

Note that the seedlings obtained from the germination study must be saved for Section 2, Activity 5 and Section 4, Activity 3. At least fifteen seedlings should be saved.

Materials and Equipment

The list that follows is for one individual or group.

The following will be needed:

- broccoli stalk
- tweezers
- forty radish or bean seeds
- two saucers
- paper towel
- plastic wrap
- two beakers or glasses
- soil for several small flower pots
- one 15 cm flower pot and a few smaller pots
- one large carrot
- one metre of 5 or 6 mm glass (or aquarium) tubing
- one one-hole stopper for the tubing (or adhesive tape)
- one large cup (or small pot)

] not needed for the alternate pathway provided

- pancake (or corn) syrup
- one celery stalk with leaves attached
- red and blue food colouring
- home-made 30 cm × 30 cm × 30 cm cardboard box
- several toothpicks
- one large carrot with leaves attached

] or [

- an African violet plant
- plastic container with lid

]

- an unhealthy indoor potted plant (optional)
- a raisin

Since students themselves design some of their experimental work, some additional materials and equipment may be involved.

Media

Video cassettes may be available from your local school jurisdiction or the Alberta Distance Learning Centre – Junior High Department.

The following videos, though not incorporated in the pathways, may be found useful:

Lifetime: Growing Plants for Space
Seeds
Seeds and Seasons

Evaluation

The evaluation of this module will be based on four section assignments.

Section 1 Assignment	**25%**
Section 2 Assignment	**25%**
Section 3 Assignment	**25%**
Section 4 Assignment	**25%**
TOTAL	**100%**

Section 1: Plant Structure

Section 1: Activity 1

1. In the chart provided, list several items you have for breakfast or supper. You may have had bread, jam, peanut butter, eggs, ham, sausages, cereal, and milk for breakfast. For supper you may have had potatoes, beans, meat patties, and tea.

   To the right of each entry indicate the animal or plant source. In the third column show the diet for each of the animals listed.

   Some examples are given.

   Answers will vary but it should be seen that the primary or secondary sources for most foods people eat are plants.

Food Item	Animal or Plant Source	Animal Diet
eggs	chickens	wheat, barley, corn
bread	wheat	
jam	*stawberries*	
peanut butter	*peanuts*	
ham	*pigs*	*barley, oats*
sausages	*pigs, cows*	*barley, oats, grass*
cereal	*oats*	
milk	*cows*	*barley, oats, grass*
vegetables	*beans, spinach*	
meat patties	*cows*	*barley, oats, grass*
tea	*tea plant*	

2. Describe a plant that is visible from your window.

   Answers will vary. The description could identify the plant as being a tree, shrub, or flower. It could also include particulars regarding the colour of the foliage and the approximate size.

3. List the use of plant materials in the home. For example, what are wood, paper, and cloth used for? (If a surface like a wall or floor is covered by carpet or paint, you may have to ask someone what it is made of.)

   Answers will vary depending on what the student observes. Most houses are built on a framework of spruce or fir lumber. Plywood is found in many houses and it is made of spruce. Particle board is used both in house building and in furniture. It is made of wood chips of many low-grade trees. Hardwood floors are made of oak or maple. The doors are often mahogany, while the trim around the doors and the baseboards are made of woods such as spruce, fir, hemlock, pine, oak, and mahogany.

   Siding and roofs may have cedar on them. Gyprock or drywall is covered with a layer of paper.

   Paints contain the oil of many different plants like canola.

   Furniture is also made of ash, birch, maple, cherry, walnut, oak, and many other types of wood.

4. Go to your clothes drawer or closet and look at the tags in your clothes. Are any of these clothes made of cotton, linen, or rayon? Which type of clothes contain these materials?

   Cotton is the most common fibre. You will find it in jeans, underwear, T-shirts, sweatshirts, jogging suits, sport socks, and runners. Many of the highly coloured shorts and blouses you see are made of cotton.

   Expensive dresses, men's dress shirts, and table cloths are sometimes made of linen. Some lightweight dressy garments are made of rayon.

Note that cotton, linen, and rayon all come from plant materials.

Section 1: Activity 2

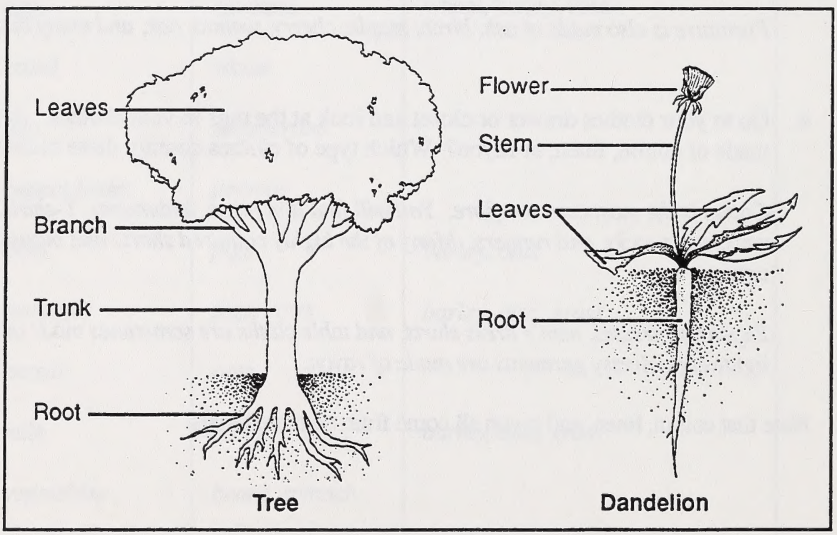
1. Using what you already know, think about (brainstorm) all the words that describe plant structures, eg. leaf, stem, and bud. List these words.

   Answers will vary. Students should have some of these but they may have thought of even more.

   - *trunk*
   - *branch*
   - *twig*
   - *leaf*
   - *root*
   - *bough*
   - *crown*
   - *flower*
   - *fruit*
   - *bark*
   - *stem*
   - *buds*
   - *berry*
   - *seed*

2. Now make a drawing of a tree and a dandelion plant. Draw them so that they show the parts of the plant listed in question 1.

   The drawings should be like these.



3. Which words did you use for both plants?

   Both trees and dandelions have roots, leaves, and possibly flowers.

4. Can you think of a plant that does not have these parts?

   The student might have thought of a fungus such as the mushroom. It is a plant that does not have much in common with green plants.

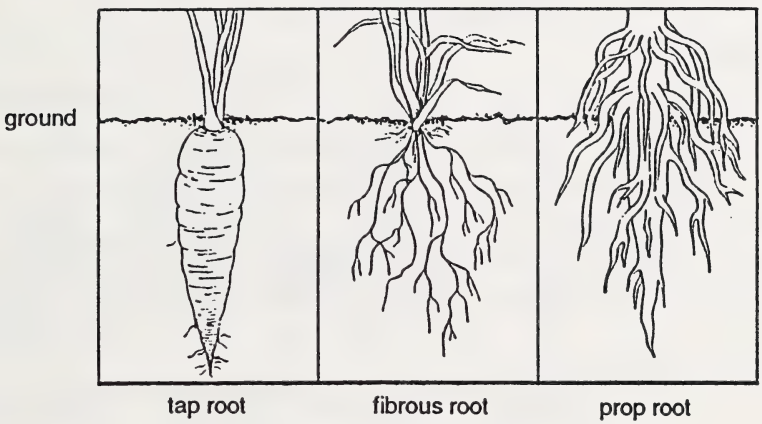
Section 1: Activity 3

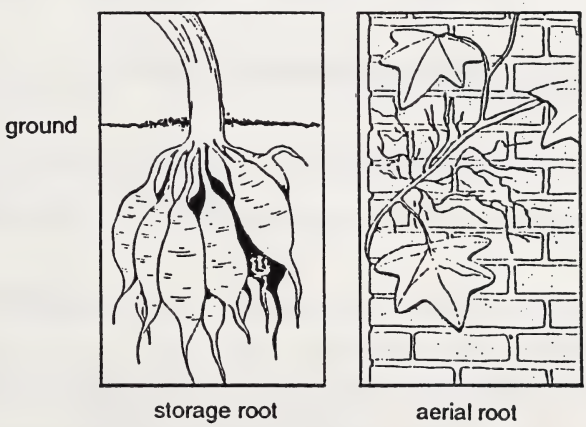
1. What root vegetables have you eaten?

   Common root vegetables are carrots, turnips or swedes, beets, parsnips, radishes, salsify, and horseradish.

   Ginger is made from the roots of the ginger plant. Tapioca comes from the root of the cassava plant. Licorice comes from the root of the licorice plant and root beer is made from the root of the sassafras tree.

   Note that potatoes, sweet potatoes, and yams are not roots; they are really a special type of stem called a tuber.





2. The previous illustration shows five root types. Which ones do you suppose would be edible?

   Only the tap root and the storage root are usually edible.

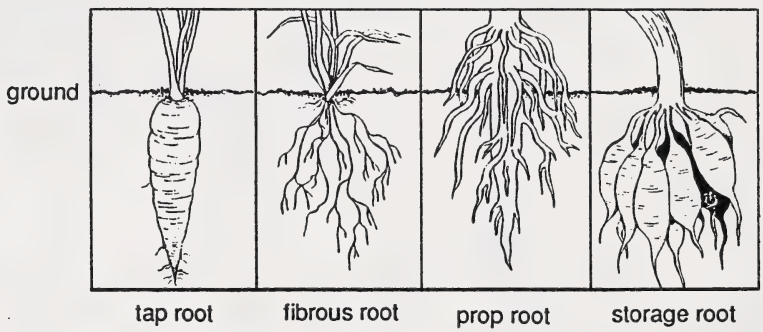
3. Look at your answers for question 1. What type of root do you think the ones you ate were?

   All of the roots in question 1 are tap roots. Potatoes are tubers rather than roots.

4. Go outside and find a small plant (no higher than knee-high). Check with your learning facilitator that you are not digging out anything that shouldn't be dug out. With a spade, dig it out carefully. Carefully remove the loose dirt. In a bucket of water rinse off all the remaining dirt from the root. Identify the type of root it is. Make a diagram of the root. If you have done this quickly, you can replant the plant right away. If you cannot obtain a plant from outside, you may inspect the roots of a potted plant.

   The plant could have tap, fibrous, prop, or storage roots. It could not have an aerial root. The root diagram should look like one of the following:

   Root Type:



5. You can think of the various roots as structural adaptations. For each of the root types, tell what you think its special advantage is.

   A tap root allows a plant to get down deep when there is no water near the surface of the soil.

   A fibrous root allowed a plant to get more moisture from the ground because there are more little roots.

   A prop root helps a tall plant to stand in a strong wind. The plant might want to grow taller to get more sunlight.

   A storage root allows a plant to store food when water and nutrition is plentiful and to continue growing when they were not. It might help in surviving winters.

   An aerial root allows plants to get at more light. By growing on a vertical surface a plant can get more direct sunlight in the northern hemisphere. In the tropics, plants climb to compete with other plants for light.

Section 1: Activity 4

A broccoli stalk and tweezers are needed for this activity.

1. Can you think of an occasion when someone in your family gave, or was given, flowers? What kind of flowers were they?

   Answers will vary. Sample answers are given.

   Mothers often get flowers for Mother's Day. They may get roses, carnations, or chrysanthemums (mums).

   Birthdays are another occasion when people would get daisies or any type of flower.

   At Christmas, people often have poinsettias and Christmas cacti.

   At funerals lilies are a common flower.

   But there are many, many flowers that are used for many other occasions.

2. Have a look at a broccoli stalk. The green bumps on top are the closed flowers (buds) of the broccoli plant. Very carefully pluck one of the biggest ones off and name and count the parts of the flower. Hint: Use tweezers and if the buds are too small put the broccoli into a vase of water for a day.

   Broccoli has four sepals, four petals, six stamens, and one pistil. The petals are sometimes difficult to see.

3. Name and count the parts of any other flower that is available. For example, roses, tulips, or lilacs may be used.

   Answers will vary. Four is a common number for sepals and there may be from four to several petals. Stamens often outnumber the pistils.

Section 1: Activity 5

1. You also make decisions. Think back to the last time you left the house for a few hours. Write how the climate influenced your choice of clothing, transportation, and activity.

   Answers might relate to dressing against the cold in winter. Or students might have described how they dressed to stay dry. But very hot weather requires students to make decisions too. In very cold weather, students are more likely to find another method of transportation rather than walking.

Nancy really wanted to visit her friend Sue. She wondered what she should wear in the cold and the rain. Sue did not live that far away. Nancy decided to wear her jeans and blouse but to take an umbrella. It sure was cold out there. She went over to Sue's house. When Nancy arrived at her friend's house, she was dry but freezing cold.

2. Pick out four sentences and match each of them with one of the four problem-solving steps.

   a. Which sentence has to do with understanding the problem?

      She wondered what she should wear in the cold and the rain.

   b. Which sentence shows developing a plan?

      Nancy decided to wear her jeans and blouse but to take an umbrella.

   c. Which sentence relates to carrying out the plan?

      She went over to Sue's house.

   d. Which sentence relates to evaluating?

      When Nancy arrived at her friend's house, she was dry but freezing cold.

3. Apply the technological problem-solving model in your role as a farmer deciding on a crop.

   a. What problem do you have to solve as a farmer?

      The problem is knowing which crop to plant next year.

   b. What is your plan? Support your plan with reasons.

      Answers will vary. It is not expected that students give a correct answer, but the plan should show an awareness of the soil, the grain price, etc. Note that if a farmer lives in an area that has grayish soil, the farmer would not grow wheat. Where it is cold, a farmer could not grow flax. In the south, a farmer would likely not grow rye because the farmer could make more money growing canola or flax.

   c. What is involved in carrying out the plan?

      The farmer would simply plant the grain, take care of the crop, and harvest it in the late summer.

   d. How would you determine whether your problem was solved effectively?

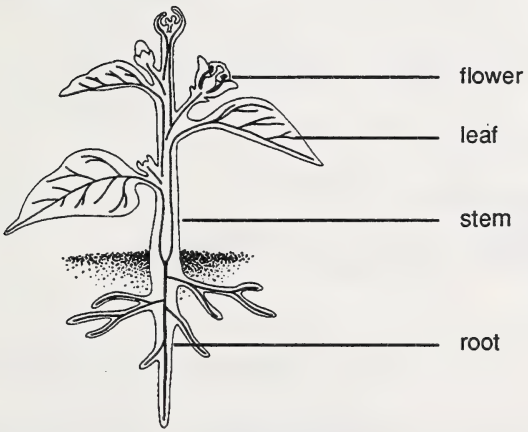
      You would find out how much grain you harvested. If you chose the right crop for your soil and predicted the weather correctly you would likely have made a good plan. If your crop did poorly you would try to find out why and change your plan next year.

Section 1: Follow-up Activities

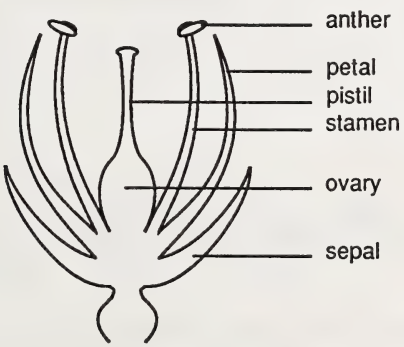
Extra Help

Compare your answers to the following diagrams.

1. Label the diagram of the plant with the correct terms.



2. Label the diagram of the flower using the correct terms.



3. Why are plants important to all other living things?

   Plants are important because every other living thing depends on them for food, either directly by eating the plants or indirectly by eating an animal that eats plants.

4. Name the two important factors influencing plant growth.

   Climate and soil are the two most important factors affecting plant growth.

5. List the four steps of the technological problem-solving model.

   The following are the four steps of the model:

   - *understanding the problem*
   - *developing a plan*
   - *carrying out the plan*
   - *evaluating*

Enrichment

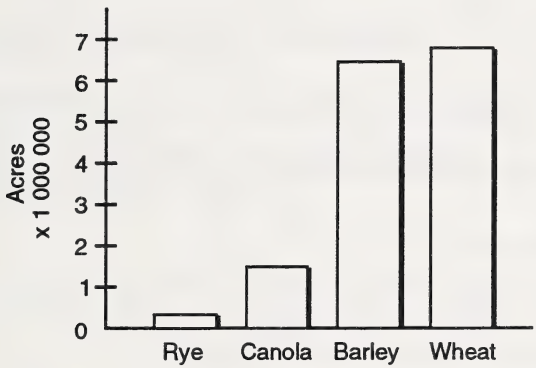
1. Using the crop information on the preceding maps, determine Alberta's most important crops. Relate the crop to the number of acres planted in this crop. List them in order of importance, starting with the most important.

   The order of crops from most important to least important is

   Wheat – 6 705 436 Acres
   Barley – 6 432 958 Acres
   Canola – 1 455 205 Acres
   Rye – 292 999 Acres

2. Make a bar graph based on the information in question 1.

   The graph could be a different size but it should have the Acres on the vertical axis. The units and bars should be clearly labelled.



3. What is the main crop in southeastern Alberta?

   Wheat is the main crop in southeastern Alberta.

Section 2: Plant Growth

Section 2: Activity 1

The following are needed for this activity:

- forty radish or bean seeds
- two saucers
- paper towel
- plastic wrap
- a beaker or glass
- soil in which to plant fifteen to twenty seedlings
- flower pots to hold the planted seedlings – one flower pot at least 15 cm in diameter or a few smaller pots

Students are to save the plants grown in this activity for Section 4, Activity 3 and Activity 5 of this section.

Students are to continue with this section while completing this activity.

1. What is the germination rate for the seeds kept in the fridge? Show your calculations.

   Answers will vary. A sample answer follows for the case in which seven of the twenty seeds in the saucer germinate.

   $$\frac{7}{20} \times 100\% = 35\%$$

2. Calculate the germination rate for the seeds kept at room temperature.

   Answers will vary. If eighteen of the twenty seeds in the saucer germinate, the rate is

   $$\frac{18}{20} \times 100\% = 90\%$$

3. How does temperature affect the germination rate?

   Cold inhibits germination. The germination rate is lower in the cold.

4. Why might it not be an advantage to plant your garden very early in the spring?

   Seeds may not germinate in early spring when temperatures remain low. The germination rate may be higher in warmer weather.

5. If you were to plan a garden and you knew how many bean plants you wanted, how would you use what you have learned to help you decide how much seed to buy?

   Since the germination rate is not likely 100 percent, you must buy more seeds than the number of plants you wanted. For example, if you wanted thirty-two bean plants, you would have to use forty seeds if the germination rate were only 80 percent.

Section 2: Activity 2

1. Do Activity 5-7, Comparing the Effects of Nutrients, on page 233 in your textbook. Answer the following.

   Textbook question 1:

   For each of the plants lacking a nutrient, both the leaves and root system were smaller and less developed.

Textbook question 2:

The plants lacking a nutrient varied in terms of root growth, stem length, leaf size, and number of leaves.

Textbook question 3:

In order for a plant to fully grow, all three nutrients must be present.

Textbook question 4:

These nutrients are necessary in large amounts for healthy plant growth. If any one of these three is missing, growth will be severely stunted.

2. A greenhouse owner told you that the tomato plants in her greenhouse had good roots and big stems and leaves, but the plants failed to grow tomatoes. What advice would you give the owner? Why?

   Since the tomato plant grew well except for the development of the tomato (fruit) itself, there is likely a deficiency in only one of the three important nutrients. The nutrient that is responsible for fruit formation is potassium. A fertilizer high in potassium, such as 5-5-30, should be recommended.

Section 2: Activity 3

A raisin is needed for this activity.

The following are needed for Part A of this activity:

- a large carrot
- a metre of 6 mm glass (or aquarium) tubing
- one one-hole stopper for the tubing (or adhesive tape)
- 50 mL pancake (or corn) syrup
- food colouring (optional)

The following are needed for Part B of this activity:

- a large carrot
- a tablespoon of pancake (or corn) syrup
- a beaker (or cup)

1. Hold your arm high above your head. How long can you hold it there? What does it feel like?

   After about 1 or 2 minutes you would notice a change in temperature. Your arm might feel a little warmer and then it would slowly get numb. After 5 or 10 minutes it may no longer be possible to hold it up.

2. Put a raisin into a glass of water for an hour. In what way does the appearance of the raisin change? Why?

   After some time the raisin will become larger and the wrinkles will disappear. The water has been pulled into the raisin due to the large amount of sugar inside the raisin.

3. How high did the liquid rise each hour?

   Answers will vary, but the student's response should indicate a rise in liquid level for several hours after the carrot is placed in water. A sample response follows:

Time	*2:05 pm*	*3:05 pm*	*4:05 pm*	*5:05 pm*	*6:05 pm*
Height above Stopper	*0 cm*	*6 cm*	*11 cm*	*14 cm*	*16 cm*

4. Did the liquid rise the same amount every hour? Give your thoughts as to why the hourly rise might diminish after a while.

   The student should find that the hourly rise becomes smaller the longer the experiment lasts. For example, in the first hour the rise could be 6 cm, in the second hour 5 cm, and in the third hour 4 cm. Students may give the following as reasons:

   - *As the syrup gets thinner and thinner, it becomes less and less effective in drawing in the water.*
   - *As the column of liquid lengthens, the pressure at the bottom increases. The higher liquid pressure opposes the movement of the water.*

5. What do you notice about the liquid level in the carrot?

   There is more liquid in the carrot after a day; the liquid level has risen.

6. Do you think that if you kept adding water to the beaker and if the carrot were long enough, the liquid would continue to rise?

   Answers may vary. Students may state that eventually the liquid will stop rising because the syrup will become so diluted that it will not have much effect in drawing in more water.

7. Do you think a syrup-filled carrot would be useful in bringing up drinking water from a well not operated by electricity?

   Answers will vary. Students should apply what they have found out about the osmosis of water into the cavity in the carrot. The water would be too sweet for drinking water. Syrup would have to be added repeatedly. The water would not rise very high. The water flow would be very slow. Therefore the carrot is not practical as a pump.

Section 2: Activity 4

The following are needed for this activity:

- one stalk of celery with leaves attached
- two glasses (or beakers)
- red and blue food colouring

1. Think back to a time when you picked some flowers and took them home. What happened if you did not put them into water right away?

   If cut flowers are not put in water fairly soon they will start to lose water and shrink. This is called wilting.

2. What change do you observe?

   The stem and leaves on the blue side are getting blue, and the stem and leaves on the red side are getting red.

3. Why do you think the leaves were to be kept on the celery?

   The loss of water from the leaves causes the water to be pulled up the stem.

4. Think of ways that you could use this knowledge. Write down your ideas.

   Some people make money dyeing carnations and other flowers and selling them for special occasions.

Section 2: Activity 5

A home-made cardboard box 30 cm by 30 cm by 30 cm is needed for this activity. Six of the seedlings from Activity 1 are also needed.

1. Have you ever seen a fungus? Describe where.

   Most students will refer to moulds on bread or fruit. You may wish to relate the following to students:

   Bread moulds can actually be beneficial to people, and the moulds on some cheeses are highly prized. Fruits get mouldy too and are then called spoiled. One of the most expensive food plants is a fungus called truffle. Truffles look like little black shrivelled nuts and are found deep under ground in France. The sensitive noses of specially trained pigs are used to find them. A pound of truffles costs hundreds of dollars.

   Some biologists do not consider fungi to be plants.

2. Give a word equation to represent photosynthesis.

   $$\textit{Carbon dioxide} + \textit{water} \xrightarrow[\textit{light}]{\textit{chlorophyll}} \textit{starch} + \textit{oxygen}$$

   *For the word **starch**, students may substitute carbohydrates or food.*

3. Tell how the word *photosynthesis* is derived from the Greek language.

   ***Photosynthesis** comes from the Greek words **photos**, meaning light; **syn**, meaning together; and **thesis**, meaning putting.*

4. From where does the plant obtain the carbon dioxide it uses?

   The carbon dioxide comes from the air.

5. Which plant structure is most important for food production?

   Most of the food production occurs in the leaves of plants.

Comment: Students are to continue with the next section while completing this activity.

6. Compare the growth of the plants in the box with those not in the box.

The plants near the window grow normally but the plants in the box grow sideways toward the light. The growth of the boxed plants speeds up and they do not develop leaves until they get close to the light. As soon as they get out of the box they resume normal growth.

7. Which plant grew faster? Which one was greener?

The plants in the box grew faster, but the plants near the window were greener.

8. How would this help you decide whether plants are getting enough light?

If plants bend toward the light and grow tall, thin, pale, and with few leaves, then there is a lack of light.

Section 2: Follow-up Activities

Extra Help

1. List two ways in which plants are like people.

Plants are made of cells. Plants grew up from small to large. Plants need nutrients. Plants respond to changes in the environment.

2. What does nitrogen do for a plant?

Nitrogen stimulates the growth of stems and leaves.

3. If just after planting everything was fine with a plant except that the roots were too small, what would be missing?

Very likely the plant would need phosphorus because this mineral encourages root growth.

4. Explain how transpiration is involved in colouring a white flower blue.

A cut flower can be put into water with a blue dye in it. As the water evaporates from the leaves and flower, blue water is pulled into the plant to replace the water in the leaves and flower.

Enrichment

There are many products available to help you to grow plants indoors. Visit your local hardware store, plant nursery, or department store garden centre to find out what these products are. Report your findings.

Answers will vary. For example, the student may report about soil mediums, insecticides, and rooting hormones.

Section 3: Plant Propagation

Section 3: Activity 1

1. Think of as many fruits as you can. Name several of these fruits and describe the seeds briefly. (for example: tomato – many seeds the size of a pinhead)

   Answers will vary. The following may be included:

   Apples – about half of a dozen seeds 2 - 4 mm long
   Pears – about half of a dozen seeds 2 - 4 mm long
   Cherry – one seed about half of a centimetre diameter
   Watermelon – hundreds of seeds 5 - 10 mm long
   Pumpkin – hundreds of seeds flat and 1 - 2 cm long
   Peas – 5 - 10 round seeds about 3 - 8 mm diameter
   Beans – 5 - 10 flat, oval seeds 5 - 20 mm long (Broad beans)
   Plums – 1 oval seed about 1 cm long
   Corn – hundred seeds or more 6 - 8 mm diameter
   Nuts – 1 Hazelnut seed (about 1 cm diameter)
   Walnuts (about 3 cm diameter)
   Almonds (about 1 - 2 cm long)
   Grain – up to seven dozen seeds 3 - 7 mm long
   Rice, Wheat, Barley, Oats, Rye

2. List five more plants not listed in question 1 that have seeds surrounded by fruit flesh.

   Possible answers include all those listed in question 1 except nuts, grain, bananas, and seedless grapes. Other choices may be peaches, nectarines, apricots, raspberries, and currants.

3. Think of three plants that propagate by having their seed pass through the digestive track of a creature. Write their names.

   The following pass through a digestive track of a creature: raspberries, blueberries, currants, gooseberries, saskatoons, salalberries, chokecherries, elderberries, and mountain ash.

4. In Canada's north one can often find raspberries growing where people live. Sometimes the outhouses are completely surrounded by beautiful raspberry bushes. Using what you have learned, explain how this can occur.

   People are very fond of raspberries and their vitamins make them a healthy fruit to eat. However, the seeds of the raspberry are not digested in the stomach. After they are excreted, they often start growing near the outhouse. When they do start growing, people will also encourage their growth.

Section 3: Activity 2

1. Match the flower with the likely pollinator.

   (1) Bees, which like bright flowers

   (2) Hummingbirds, which have long, thin beaks and can hover near a flower

   (3) Butterflies, which have long, thin tongues and can sit on a flower

   (4) Wasps, which are very aggressive even towards other wasps

   (5) Flies, which like the stink of rotting things

   (1) a. *Bees will be attracted to the bright yellow dandelions.*

   (2) (3) b. *Hummingbirds and butterflies can reach into the long tubular flowers for nectar.*

   (4) c. *The wasp will likely attack the wasp-like stripes of the daffodil. The stripes may scare off other insects.*

   (5) d. *Flies will be attracted to the stink of the rafflesia.*

2. Can you think of any other appealing characteristics that you would like to breed into some of your favourite plants?

   Answers will vary. Students might want a sweeter apple, a seedless plum, or maybe seedless raspberries. Perhaps they may want unusually coloured fruits like yellow tomatoes (they already exist) or purple beans (they exist too) or seedless watermelons. A more nutritious plant might be desirable.

3. a. Which country is known for breeding roses?

   England is known for breeding roses.

   b. Which country is known for breeding tulips?

   The Netherlands is known for tulips.

Section 3: Activity 3

The following are needed for Part A of this activity:

- a carrot with leaves attached
- four toothpicks
- a glass or beaker

The following are needed for Part B of this activity:

- cottage cheese container or similar container
- an African violet plant from which to remove a leaf with its stem

1. What do you think is the largest part of your body that you can regrow?

   Answers will vary. People are not able to regrow very large organs. The liver is one organ that will regenerate even if more than three-quarters of it has been removed or injured. It is the only major organ that will regenerate.

   Other tissue like skin will regenerate relatively well as seen with small cuts. Even fingertips and the tips of noses grow back to some degree. Bones regenerate as well (they are not living tissue).

2. Which part of the carrot did the plant grow back?

   The root part of the carrot regenerated. It may take a long time to grow the full root back, and depending on the circumstances, it may look similar but it won't look the same as the original.

3. What part of the African violet developed after the leaf and stem were taken from the original African violet plant?

   Roots developed on the bottom end of the stem.

Note to Facilitator: Please encourage the student to try one of these activities if he/she shows the interest.

4. If you grew a potato plant from only one of the eyes, which parts of the plant would the potato grow back?

   The potato is a bump on the stem of the potato. It is used for storing food. So the potato would have to regrow the root, the leaves, and more stems above ground.

5. To whom would this knowledge be valuable? Why?

   Aside from scientists, this knowledge would also help horticulturists (people who breed and grow plants). If a valuable plant was injured or attacked by insects or a disease, the bad part could be cut off and the rest could be regrown.

   If a houseplant was too large, the top or bottom could be cut off and a smaller plant could be regrown. This is often done to fast-growing plants like diefenbachias, rubbertrees, and philodendrons.

Section 3: Activity 4

1. Can you think of one reason why it would be fascinating to have another you?

   Answers will vary. Students might feel that they could have a friend who would understand them or just someone to spend time with. They might feel that because they are so nice that it would be good to have two of themselves. Or they might just be curious to see what that would be like.

2. Go outside and look for one of the previously described plants. Can you find evidence of sucker shoots or runners anywhere? If not, ask your facilitator for information.

   Hint: You may have to look for last year's growths. Describe the pattern they form with the parent plant.

   There are two patterns that prevail:

   - *Suckers will spread out from the parent plant in a circle. Poplars and lilacs grow like this.*
   - *The suckers of quack grass grow in zigzag or straight lines away from the plant. Strawberries are somewhere in-between depending on how many suckers it has. If there are only a few they may get old enough to send out suckers themselves; then they would resemble quack grass.*

3. How could sucker shoots become a problem for a gardener? How could they become a problem for the plant?

   Sucker shoots can take some strength away from a plant. They can also take over valuable garden space. Plants can suffer because these shoots will grow up and compete with them for food.

Section 3: Activity 5

1. What kind of organs have you heard of that are being transplanted into people?

   Some body parts that are transplanted are the liver, the kidney, the heart, skin (usually from the same person), bone marrow, and parts of the eye.

2. Why is grafting used to make new plants?

   A type of plant having a desirable flower or fruit can be attached to a hardy root. Also, grafting a cutting onto an established part of a plant can give the cutting the advantage of several years of growth.

3. Describe an imaginary tree that bears all of your favourite fruits. Can you think of an advantage in having a variety of fruit on just one tree.

   There is no limit to the student's imagination for the choice of tree. One advantage may be that with limited space one could not grow several full-sized trees to get all the fruit. In other words even small property owners could grow a range of fresh fruit.

   It should be noted that in reality not all plants can be grafted together. There must be compatibility between the parts grafted.

Section 3: Follow-up Activities

Extra Help

1. How are seeds produced?

   Seeds are produced by the plant after the pollen has fertilized the pistil. The ovary grows into seed.

2. Name several plant parts that can be grown into full plants.

   A piece of root with the stems and leaves still attached (carrot), a part of a tuber (potato), and individual leaves, stems, or roots can also be grown depending on the type of a plant.

3. What is a general name for the type of reproduction that involves growing complete plants from a part of the root, stem, or leaf?

   It is called asexual propagation.

4. Describe the role a bee plays in the reproduction of plants.

   The bee helps to bring the pollen from the male part of the flower to the female part in sexual propagation. Bees are pollinators.

5. Compare how the seeds of a dandelion and the seeds of a raspberry are distributed.

   The seeds of the dandelion are blown about by the wind. They are very small and light and have a fuzzy part that catches the wind.

   Raspberry seeds have a tough coating and are surrounded by fruit flesh. They grow in clusters and are quite tasty. Birds or other animals must eat them and that is how they are carried away to new locations.

Enrichment

1. Develop two different plans to make the blueberry seeds germinate.

   The student may suggest feeding the seeds to another animal to remove the coating and then to plant the seeds.

   Another solution may be to use vinegar or another acid to remove the outer coating and then to plant the seeds.

   Or, the seeds could be scratched by fine sandpaper to remove the outer coating.

2. What choices would be left to you if all your efforts in sprouting the seeds did not pay off?

   Aside from buying the plants elsewhere one could consider a number of the asexual propagative techniques like rooting the stems or leaves of the blueberry plant.

Section 4: Growing Plants: Problems and Solutions

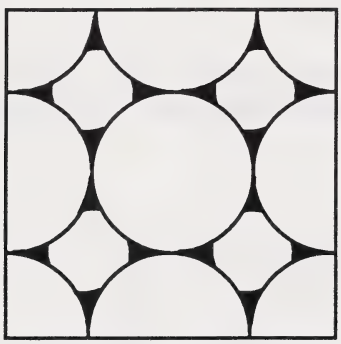
Section 4: Activity 1

1. Think back to what you have learned, and list some of the things that make soil important to plants.

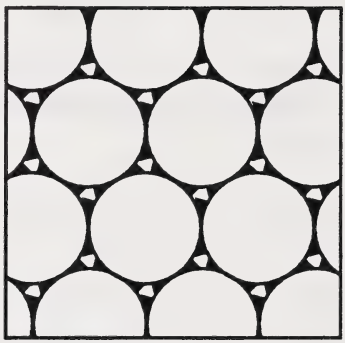
   Soil provides support for the plant, carries the water to the plant, and contains nutrients.

2. Complete the pictures of silt and clay by showing the water and air. Label your completed diagrams.

   The water should only occupy the areas where the circles are close together.



Silt



Clay

3. Comment on the amount of air and water in the three soils.

   Sand contains more air than water. Clay contains more water than air. Silt contains more or less equal parts of both air and water.

4. How well do you think gravel will retain water? Give reasons for your answer.

   Answers can vary but reasons should be provided. Gravel is made of very large particles. By comparing sand, silt, and clay I found that the larger the particles the less the water. Therefore, gravel should not hold much water.

5. Suppose that you are a farmer and a good part of your land is bare sand with hardly a thing growing on it. Most of your income comes from raising pigs, but you would really like to be able to use that sandy spot for growing some of the food the pigs are eating. Develop a plan to make that sandy spot into usable soil. Try to think of ways other than buying soil and trucking it in.

   The farmer could wait for the small amount of vegetation to grow and die. After many, many cycles, the dead vegetation would have provided some humus for the plant to grow in. This process also happens naturally but then it takes about 400 years to make 1 cm of humus.

   Another plan would be to put the manure from the pigs on the sand and mix the two together.

   A third choice would be to buy soil and truck it in.

   In the first two plans the soil would still drain very quickly and plants may need to be watered during dry spells.

6. Why is peat moss added to soil?

   Peat moss increases the amount of water that soil can hold.

7. What is the purpose of adding vermiculite or perlite to soil?

   Vermiculite and perlite increase the air in soil.

Section 4: Activity 2

An unhealthy potted plant may be used in this activity.

1. In biological controls, what is used instead of human-made chemicals to control plant pests.

   In biological controls other living organisms are used to control plant pests.

2. Give an example of a biological control used by plant growers.

   Answers can vary. Some biological controls are the following:

   - *The preying mantis is used to eat grasshoppers.*
   - *The assassin bug is used to suck the fluids out of other bugs.*
   - *Geese are kept in strawberry patches to control weeds.*
   - *Dill is planted near tomato plants to entice hornworms away from* tomato plants.

3. Now use the chart in a reverse fashion. What would be some symptoms in a plant that had been given too much water or too little water over a period of time.

   In either case the plant drops and its leaves hang over the edge of the pot. To use the chart you find the corresponding diagnoses and follow the arrows in reverse to the symptom which in this case is symptom 1.

4. Do question 6 on page 269 of your textbook.

   Textbook question 6. (a):

   Due to too much water in the soil, the roots are dying of suffocation and root rot.

   Textbook question 6. (b):

   There are furry spots not furry patches so symptom 4 is not present. The chart should be followed to symptom 7. The plant likely has mealybugs.

   Textbook question 6. (c):

   Symptom 2 applies. Either the plant is not getting the right amount of light or the wrong fertilizer is being applied.

   Textbook question 6. (d):

   Aphids are on the plant.

5. Do question 8 on page 269 of your textbook.

   In the top photo, the scale insect is shown. In the middle photo, there are aphids. In the bottom photo is a weevil.

   The scale insect is killed by repeated application of alcohol to it by means of a swab. The aphids can be removed by washing the plant with soapy water. The weevil must be physically removed using something like tweezers.

6. If you can obtain an unhealthy plant to look at, tell what you would do to help the plant recover. Indicate how you used the diagnosis chart to arrive at your recommended treatment.

   Answers will vary greatly. Students should indicate how the diagnosis chart was used to prescribe a treatment. The student's work can be validated by looking at the plant used by the student.

Section 4: Activity 3

The way the student designs the plant study determines what is needed for this activity. The design may have to be modified to avoid the need for items that are difficult to obtain.

1. What question do you want answered by your investigation?

   The question should be clear and testable. For example, how does the distance from the light affect the height of the plant? (The light is assumed to be a light bulb or a window.)

2. What is your hypothesis?

   The hypothesis should identify a possible cause-and-effect relationship. For example, the greater the distance from the light, the shorter the plant will be because the amount of light decreases with distance and plants need light during photosynthesis.

The responding variable in your investigation is likely plant height or the change in plant height. The manipulated variable is the factor you change in order to study its effect.

3. What is the manipulated variable in your investigation?

   Answers will vary. The manipulated variable could be the amount of fertilizer or the temperature. In investigating the effect of the distance from the light on plant height, the manipulated variable is the distance from the light.

4. What procedure will you be following?

   In the procedure, all factors other than the manipulated variable must be kept constant.

   For example, in the investigation of the affect of distance from the light, the temperature, soil, and fertilizer should not change. One procedure can be as follows:

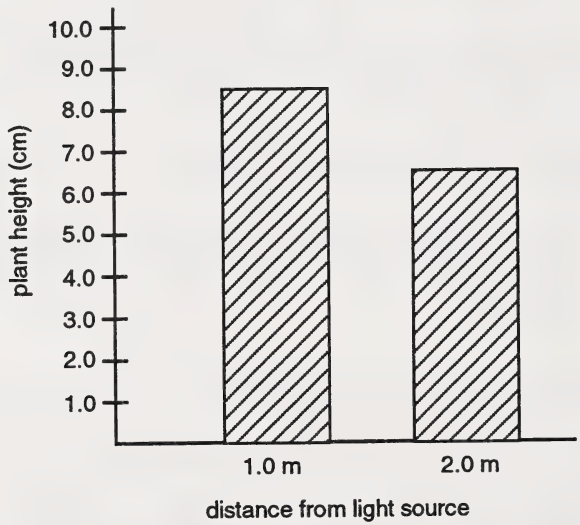
   Identical groups of plants will be placed at different distances from a light source. Plants will receive the same amount of water, fertilizer, heat, etc. Measurements of plant height will be made and recorded every day.

Comment: The procedure must be safe before the student is allowed to go on. Also, the procedure must be appropriate for the investigation and it should not require unavailable materials and equipment.

5. Record your observations. You may use a chart or a graph to present your data.

Answers will vary. A sample chart and graph are shown.

Day	*Height at 1 metre distance*	*Height at 2 metre distance*
1	*5 cm*	*5 cm*
2	*6 cm*	*5.5 cm*
3	*7 cm*	*6 cm*
4	*8.5 cm*	*6.5 cm*



6. What conclusion can you make to answer the question you started out with?

The conclusion should be supported by the data. An example of a conclusion is the following: The longer the distance a plant is from a light source, the shorter the plant is. The hypothesis is supported.

Note that there may be exceptions to the height-versus-distance relationship. If light is extremely bright, plants may burn. The plants near the light source may be stunted more. If light is extremely deficient, plants may grow more quickly due to phototropism. However, phototropism will be exhibited less by more mature plants.

Section 4: Follow-up Activities

Extra Help

1. Name three soils based on the size of the soil particle in them.

   Sandy soil, silt soil, and clay soil are three soils.

2. What relationship do the soils have to the amount of water and air held by them?

   Sandy soil holds more air than water, clay soil holds more water than air, and silt soil holds about equal amounts of air and water.

3. Name two ways in which soils can be enriched.

   Soil can be enriched by the addition of chemical fertilizer, by the addition of manure, or by planting legumes and plowing them under.

4. What does terracing prevent?

   Terracing prevents erosion by water.

5. How does varying the crops affect the spread of pests?

   By alternating crops that support different pests, epidemics are prevented.

6. How do ladybird beetles affect plants?

   They do not affect plants directly; however, they benefit plants that are infested with some small pests like aphids by eating these pests.

7. How do you tell if a plant has a pest or is diseased?

   Usually there are outward signs; for example, a change in colour, holes or spots in the leaves, or the appearance of the pest itself.

Enrichment

Think of a number of reasons why it would be an advantage to have plants perform functions like the ones mentioned. Consider the impact on the environment of plants performing those new functions.

Answers will vary. Some of the points should be like the ones listed.

If a plant could be made to produce a pesticide for example it would

- *use basic materials instead of nonrenewable resources*
- *manufacture the pesticide only and not a number of pollutants that would affect the health of residence near the factory*
- *provide work for people who are not necessarily trained in manufacturing sophisticated chemicals but could grow the plants (third world countries)*
- *not create any waste products that are difficult to dispose off*
- *require fewer resources like money, expertise, and time once the plant was developed*

This booklet cannot be purchased separately;
the Student Support Guide is not available
as an individual item.

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